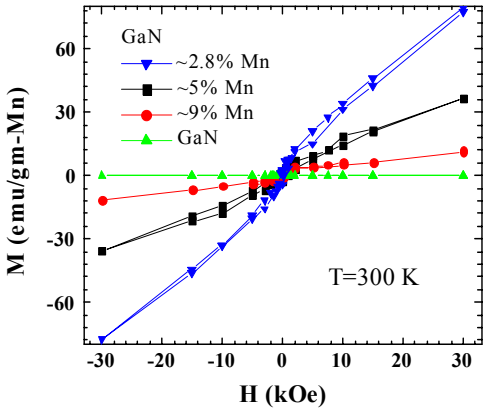
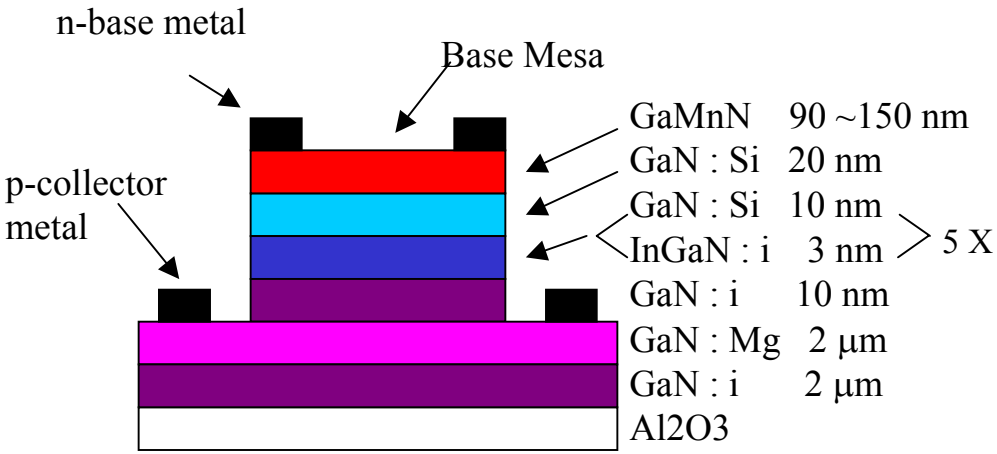
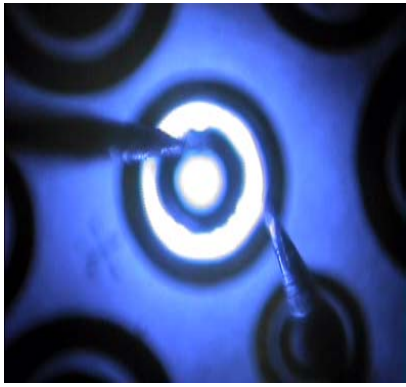
Room Temperature Ferromagnetism in GaMnN



Ferromagnetism in GaMnN



GaN-based spin led



Blue emission from operating led

Materials Science/Characterization of Room Temperature Ferromagnetic GaMnN Semiconductor, S.J. Pearton, U. Florida; DMR 0101438.

Recent predictions (Dietl et.al. Science 287, 1019, 2000) of room temperature ferromagnetism in GaN doped with Mn has provided a challenge to materials scientists to be able to synthesize high quality GaMnN with Mn contents of order 3-5%. The potential payoffs are structures in which the resulting ferromagnetism can be controlled electrically, through altering the carrier density in the material by application of an external bias. The Curie temperature is predicted to be a function of both the active Mn concentration in the material and the carrier density. At left is a plot of room temperature magnetization versus field data for GaN MBE-grown layers with different Mn contents. The magnetization decreases at Mn concentrations greater than 3 at.%, as predicted by theory, since direct Mn-Mn interactions are anti-ferromagnetic. There are many potential application for ferromagnetic semiconductors, including devices such as spin fets or spin leds that exploit the spin of the charge carrier as well as its charge (Materials Today, June 2002; J. Appl. Phys.: Appl. Phys. Rev., in press 2002). We grew our n-type GaMnN films on top of a GaN/InGaN LED structure (center) and were able to operate it as a blue light source (right). We are currently measuring the extent of the polarization of the light output. Such spin-LEDs show promise for encoding optical signals since they have an extra degree of freedom beyond simple wavelength or intensity, i.e. their output is partially polarized. Our work, supported by NSF, represents a number of breakthroughs, including realization of n-type GaMnN with room temperature ferromagnetism; synthesis by MBE, which is a standard industry-proven method of thin film growth; development of ohmic contacts, etching and other materials processing methods; use of a complex heterostructure to examine issues such as spin injection efficiency across interfaces, simulating a practical device.